Committee on Earth Observation Satellites

GHG White Paper

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CEOS 2018 SIT Technical Workshop

Climate and Carbon Observations, 2.5

EUMETSAT, Darmstadt, Germany

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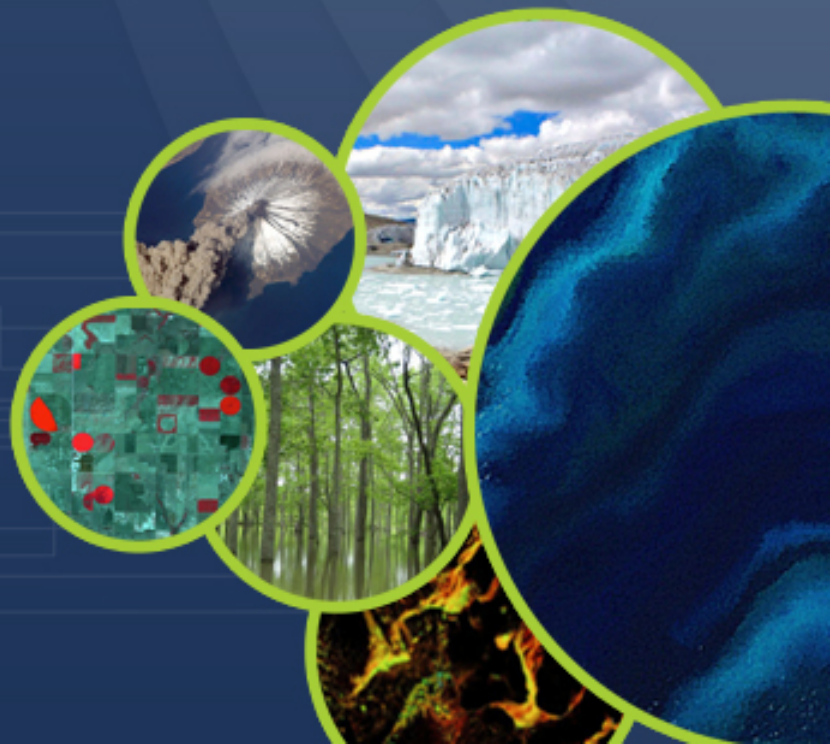
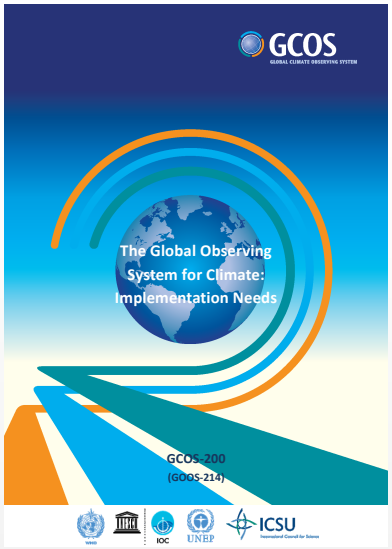


Background
Action T71 from GCOS IP 2016



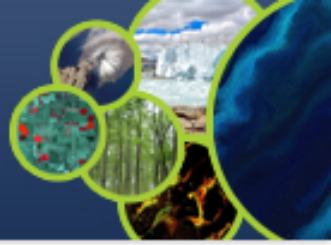
Action T71:	Prepare for a carbon-monitoring system
Action	Preparatory work to develop a carbon monitoring system to be operational by 2035; Development development of comprehensive monitoring systems of measurements of atmospheric concentrations and of emission fluxes from anthropogenic area and point sources to include space-based monitoring, in situ flask and flux tower measurements and the necessary transport and assimilation models
Benefit	Improved estimates of national emissions and removals
Time frame	Initial demonstration results by 2023 – complete systems unlikely before 2030
Who	Space agencies
Performance indicator	Published results
Annual cost	US$ 10–100 billion

"Specifically CEOS and CGMS will undertake, over the next few years, dedicated preparatory work in a coordinated international context…:

- The definition of an architecture of space component elements to address the requirements of a CO_2 and GHG monitoring system , … This will provide a global holistic perspective both from the point of view of existing and planned space segment assets as well and that for an optimum global constellation.
- The documentation of best practices on the relationships between individual space agencies and their counterparts working on the modelling aspects, the inventories and in-situ data provision, …
- The further consolidation of partnerships and collaborations between the relevant international entities including: the relationship between CEOS and CGMS on the space component aspects, the partnership with the WMO and GEO on the broader framework, … and finally the relationships with GCOS itself, UNFCCC and IPCC TFI process in better defining the role for space-based observation in the inventory guideline process."

Mark Dowell, 6/2018

Approach:
The CEOS Chair Initiative on GHGs



Specific Chair Initiative : Laying the foundation for an international CO_2 and GHG monitoring system

Three specific activities are foreseen for advancing this effort in 2017-2018:

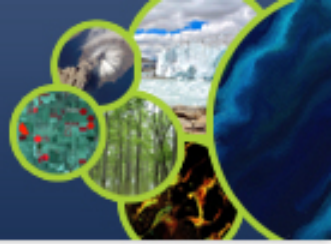
1. Facilitate the completion and follow-on activities of the **AC-VC whitepaper on defining an optimum constellation for CO2 and GHG monitoring**, including the joint competences of CEOS and CGMS, and in the general framework of the continued implementation of the CEOS Carbon Strategy
2. **Advance the relationship with CGMS for an operationally implemented and sustained observation capability**. Consider establishing a formal working relationship between CEOS and CGMS as with the successful ongoing relationship on Systematic Observations of ECVs in support of UNFCCC.
3. **Place the space segment in the broader context of a fully sustained system for CO2 monitoring**. Individual CEOS Agencies have counterparts in their individual countries/regions who have responsibility for Inventories, the required modelling, in-situ infrastructure and the ground segment elements.

Objectives of the AC-VC White Paper

The CEOS Chair commissioned the Atmospheric Composition Virtual Constellation (AC-VC) to define the key characteristics of a global architecture for monitoring atmospheric CO_2 and CH_4 concentrations and their natural and anthropogenic fluxes from instruments on space-based platforms to:

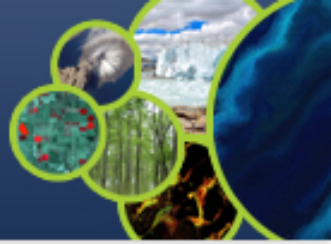
- reduce uncertainty of national emission inventory reporting, identify additional emission reduction opportunities and provide nations with timely and quantified guidance on progress towards their emission reduction strategies and pledges (NDCs); and
- track changes in the natural carbon cycle caused by human activities (deforestation, degradation of ecosystems, fire) and climate change (drought, temperature stress, melting permafrost and changes in ocean thermal structure and dynamics).

AC-VC White Paper Approach



- Incorporates contributions from
  - 2017 and 2018 CEOS SIT, AC-VC and CEOS Chair Priority meeting and 2017 and 2018 CGMS meetings
  - 83 authors from 45 organizations
- White Paper Structure, content, and intended audiences
  - Executive Summary (2 pages)
    - Overview of objectives and approach
    - Intended for policy makers and CEOS/CGMS Agency leads
  - Body of report (75 pages)
    - Documents science background and requirements, current and near-term mission heritage, and system implementation approach
    - Intended for program scientists and project managers
  - Technical Appendices (42 pages)
    - "Textbook" summarizing state-of-the-art in observation capabilities and analysis methods to justify system-level requirements
    - Intended for scientists, engineers, and inventory community

White Paper Contents



Executive Summary

Chapter 1: Introduction

Chapter 2: Retrieving Fluxes from Atmospheric CO_2 and CH_4 Measurements

Chapter 3: Space-based CO_2 and CH_4 Measurement Capabilities and Near-term Plans

Chapter 4: The Transition from Science to Operations

Chapter 5: Designing an Operational LEO Constellation for Measuring Anthropogenic CO_2 Emissions – The Sentinel CO_2 Initiative

Chapter 6: Integrating CO2 and CH4 Satellites into Operational Constellations

Chapter 7: Conclusions and Way Forward

Appendices

A1: Remote sensing retrieval methods for estimating XCO_2 and XCH_4 from observations of reflected sunlight

A2: Methods for quantifying surface fluxes of CO_2 and CH_4 from space-based XCO_2 and XCH_4 estimates

A3: Observation system simulation experiments (OSSEs)

A4: Lessons learned from SCIAMACHY, GOSAT and OCO-2

A5: Greenhouse gas monitoring satellites from commercial organizations & non-governmental organizations

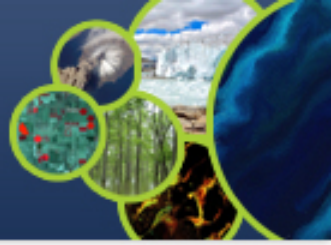
A6: Advantages of LEO, GEO and HEO vantage points

A7: CEOS Agencies implementing CO2 and CH4 missions

A8: Acronym List

References Cited

Proposed CEOS Actions



1. Create linkages with the ground-based GHG measurement community and stakeholders in the inventory and policy communities (in particular the UNFCCC), to refine the requirements and implementation approach;
2. Exploit the capabilities of the CEOS member agencies, Coordination Group on Meteorological Satellites (CGMS) and the WMO Integrated Global Greenhouse Gas Information System (IG^3IS) to integrate available and planned space-based sensors into a constellation that can provide prototype space-based CO_2 and CH_4 product in time to inform the bottom-up inventories for the 2023 global stocktake; and
3. Use the lessons learned from the development of this prototype product to refine the requirements for a future, purpose-built, operational, space-based constellation that more completely addresses the objectives cited above in time to support the 2028 global stocktake.

White Paper Status and Plans

- The AC-VC GHG White Paper is complete and ready for review by the CEOS SIT Technical Workshop
  - This should close Action CARB-12 - White paper on a carbon observation constellation
- If the paper and its recommendations are accepted
  - Proposed actions will be brought to the Plenary for disposition
  - AC-VC will work with CEOS and CGMS to implement to a (new) CO_2/CH_4 focus within WGClimate
    - WGClimate is already a joint working group with CEOS and CGMS and has existing interfaces with GCOS, WMO, and IPCC
    - AC-VC will continue to support GHG constellation development and synergistic GHG and atmospheric composition observations and modeling efforts